proved and industrialization is proceeding more rapidly.

Whatever these side effects, the main impact is an obvious benefit to mankind: the deferment of a giant collision between once near static food supplies and a growing population. But Dr. Borlaug himself emphasizes it is only a deferment. The Green Revolution, he says, "offers the possibility of buying 20 to 30 years of time . . . in which to bring population into balance with food production." After that, the inexorable Malthusian forces will once again begin operating—unless man uses the time to achieve broad scale population control. □

PHYSICS, CHEMISTRY NOBELS

Magnetism to metabolism

Work on the behavior of magnetic matter in two quite different realms of nature, astrophysics and solid-state physics, brought the 1970 Nobel Prize in Physics this week to a French physicist and a Swedish-American physicist.

Dr. Louis Néel of the University of Grenoble in France gets one-half the award for his work on the magnetism of solids. He is especially renowned for his work on the way the magnetic fields of atoms and groups of atoms inside a solid align to give different forms of over-all magnetic behavior to the solid.

The Swedish Academy of Sciences cited Dr. Néel particularly for his work on ferromagnets and antiferromagnets, and on ferrites, compounds of iron that are magnetic without being electrically conducting. His work has many important applications in the technology of electronic devices.

Dr. Hannes Alfvén, formerly head of the Institute for Plasma Physics at the Stockholm University of Technology and now a teacher at the University of California at San Diego, was chosen for his work in magnetohydrodynamics, the study of the magnetic behavior of electrically conducting fluids.

The most widely studied conducting fluids are the plasmas of ions and electrons used in attempts to produce controlled thermonuclear fusion. Since controlled fusion experiments usually try to confine plasmas by means of magnetic fields, detailed knowledge of plasma behavior under such influences is necessary. Dr. Alfvén once headed Swedish research in nuclear fusion, but left that post over a policy disagreement in 1967.

Most recently Dr. Alfvén has concentrated on another aspect of magnetohydrodynamics, the behavior of plasmas in astrophysics. Ionized gases are found in the atmospheres of stars and in clouds that pervade the galaxies. Since magnetic fields are also present in these places, magnetohydrodynamics is basic to the understanding of the evolution of both galaxies and individual stars. Dr. Alfvén has put forth a theory in which the centers of galaxies consist of large clouds of two kinds of plasma, one made of ordinary particles, the other of antiparticles. The violent interaction of the two is supposed to govern the evolution of the galaxy. The Nobel citation refers to Dr. Alfvén's "fundamental work and discoveries in magnetohydrodynamics with fruitful applications in different parts of plasma physics."

At the same time that the Swedish Academy revealed the physics award, it announced that the Nobel Prize in Chemistry goes to Dr. Luis F. Leloir, a 64-year-old Frenchman who is a naturalized citizen of Argentina. Both awards are worth $78,400 each.

Citing Dr. Leloir's contributions to science, the Academy said: "Few discoveries have made such an impact in biochemical research as those of Dr. Leloir. His work and the work inspired by him has given us real knowledge in wide fields of biochemistry, where earlier we had to resort to vague hypotheses."

Specifically, Dr. Leloir's findings involve the complex processes by which the body metabolizes carbohydrates or sugars, converting one sugar to another in biosynthetic systems. His contributions began with the discovery of a sugar nucleotide called uridine triphosphate. He went on to show that this energy compound reacts with sugars to form a second product, uridine diphosphate, a complex sugar compound which is an important intermediate in carbohydrate biosynthesis.

From reactions involving these agents, the body synthesizes glycogen, a substance that permits storage of carbohydrates for future use. In addition UTP and UDP are vital to the synthetic processes by which glycolipids and glycoproteins are made. These latter materials are the building blocks of cell membranes and thus are essential for maintaining all normal cellular activity.

Dr. Leloir's research dates from the late 1940's when he first showed that the conversion of one sugar to another depended upon the activity of a third substance which turned out to be UTP. Said one of his colleagues after hearing of the award, "It is no surprise he got the Prize. We've been predicting it for years." Dr. Leloir, himself, seemed to have mixed feelings about the publicity. "I am certainly very honored," he said, "but the Prize will cause me problems. I will not be able to work in the same kind of peace and quiet that I used to." □

MILLIONAIRE ECONOMIST

An obvious Nobelist

There is a basic economic tenet holding that, "Them as has, gits." That principle was borne out this week when Dr. Paul Samuelson, whose ubiquitous textbook, "Economics," has made him a millionaire and his name familiar to millions of undergraduates, received the further prestige of a Nobel Memorial Prize in Economics and the $78,400 that goes with it.

This year's award is only the second given for economics, and in casting over the profession for those worthy of the Prize, the Swedish Royal Academy of Sciences must have found Dr. Samuelson an obvious choice. Both through his textbook and through his other articulate and voluminous writings, both technical and popular, he has educated a generation of students, Government officials and even industrialists on the principles of the state's power to regulate and stimulate a nation's economy through its fiscal activities.

But the Academy chose to emphasize Dr. Samuelson's considerable theoretical work in economics rather than his popularizing and public roles. The award was made for his developing "static and dynamic economic theory" and for contributing to "raising the level of analysis in economic science."

The work on dynamic theory, as Dr. Samuelson explains it, refers to the process by which supply and demand approach an equilibrium point. If the supply of a good is equal to the demand at a certain price, then it is quite clear that the system is in equilibrium and will stay there. But the conditions are shifting; the equilibrium is disturbed, and which way the system will move—whether toward stability or toward wider and wider swings—depends on various factors. In his 1947 book, "Foundations of Economic Analysis," Dr. Samuelson was one of the first to describe the processes by which this equilibrium-seeking system works.

Among the effects of the economic analysis that Dr. Samuelson helped develop has been the ability to forecast economic events with greater accuracy, partly because of computer analyses that developed with it.

"Everybody does a much better job than we did 20 years ago," says Dr. Samuelson. "Our statistical methods have improved, but also we know what kind of information we want to get and now we get more of it."

Dr. Samuelson calls himself a "new" economist; he is concerned that the public sector of the economy has been "suppressed—so that we have public squalor along with private, really decadent, opulence."

But his real problem, he says, is whether "the new generation regards my book now as establishment economics. And that's why in the eighth edition I've worked so hard to get all the smugness out.

"If you are young and believe the system ought to be destroyed and a better system built, just to describe carefully how the system functions seems to take on an air of apologetics. I'm stubbornly unrepentent on that, but there really is an issue there." □

RADIOACTIVE DECAY

A fourth method

Univ. of Calif.

Cerny (r) and team: Proton decay.

Nuclear physics began with the observation that some chemical elements can spontaneously, without ouside interference, transmute themselves into other elements by radioactive decay. Observers in the late 19th century discovered two such processes: alpha decay, in which a nucleus emits an alpha particle or helium nucleus, and beta decay, in which a neutron inside a nucleus turns into a proton, and the nucleus emits an electron and an antineutrino.

Since an alpha particle contains two neutrons and two protons, its emission decreases the atomic weight by four and the atomic number of the nucleus by two. Beta decay increases the atomic number by one.

In 1938 a third method, spontaneous fission, in which certain nuclei split more or less in half, was discovered.

This week the observation of a fourth method of spontaneous nuclear transmutation by radioactive decay, predicted by theory but not before seen, was announced. Called proton decay, it is a process in which a nucleus emits a proton and decreases both atomic number and atomic weight by one.

Besides confirming theoretical predictions that proton decay should exist, the experiments should lead to a new precision in analyzing what goes on within the atomic nucleus.

Proton decay was first observed at the nuclear physics laboratory at Harwell, England, last year, but the result was not considered conclusive. It was then confirmed this summer at the Lawrence Radiation Laboratory in Berkeley, Calif. The work was initiated by Dr. Joseph Cerny, associate professor of chemistry at the University of California at Berkeley, who was on sabbatical in England. There he worked with three Canadian scientists, Drs. K. P. Jackson, C. U. Cardinal and H. C. Evans, and an Oxford University graduate student, N. A. Jelley. Later at Berkeley, Dr. Cerny worked with Dr. R. A. Gough and graduate students John E. Esterl and R. G. Sextro.

Proton decay had been predicted by theorists for some time, but it was not observed until now because it will happen only in nuclei that are seriously deficient in neutrons. Such nuclei do not exist naturally; they have to be manufactured.

In the experiments at Harwell nuclei of calcium 40 were bombarded with nuclei of oxygen 16. In the collision, two free neutrons and a free proton came away and the remaining matter fused into nuclei of cobalt 53m. At Berkeley cobalt 53m was made by bombarding iron 54 with protons. (The letter "m" refers to a metastable state, one in which the nucleus has a large amount of energy and keeps it for a long time instead of radiating it away quickly.)

The cobalt 53 nucleus has six neutrons too few for stability, and this large deficiency means that there is an essentially loose proton in the nucleus. This proton, says Dr. Cerny, is not bound by the strong nuclear force that holds all the other neutrons and protons together. It is held within the nucleus only by a barrier set up by electromagnetic forces and the ways in which the spins of the nuclear particles combine with one another.

The loose proton never has enough energy to get over the barrier, but after various lengths of time, the loose protons in different cobalt 53m nuclei find their ways through the barrier by a process peculiar to the behavior of subatomic particles called quantum mechanical tunneling.

According to Dr. Cerny, proton decay should be very useful to students of nuclear structure. The emission of a single proton presents a much simpler situation than the emission of a four-particle complex in alpha decay or the numerous fragments of spontaneous fission. The mathematical description of the simpler process should be easier to calculate, and that, says Dr. Cerny, will aid scientists "to learn sensitive details of nuclei." □

INSECTICIDE GUILTY

Death of the bees

Dead bees covered the ground in front of hives. Others, paralyzed, took several days to die. Some performed grotesque communication dances on the landing board at the hive entrance, whereupon they were refused admission by guard bees. A few still able to do normal dances made it into the hive. But their body hairs, so precisely adapted for picking up pollen, now carried dusty death to the brood inside. The powerful queen, helpless against disaster, was deposed by swarms of frenzied workers. Soon the entire hive died.

As catastrophe struck the bee colonies, perhaps the most tightly organized of nature's societies, Minnesota beekeepers erupted like a swarm of angry hornets in the direction of the Jolly Green Giant and other large canners. The death of bees in enormous numbers is the result of a recent switch by canning companies, who are the largest vegetable growers, from DDT to an insecticide thought more benign, carbaryl.

It was a bad September for bees in Minnesota. Dry weather shriveled many of the clover and alfalfa blossoms from which bees draw nectar and the bees have ranged ever deeper into the sweet corn fields. Here they got what may have seemed miracle food—carbaryl, applied to check the corn earworm and borer, had been mixed with molasses for adherence to the corn.

There was also a new predator. A small green moth, relative of the cabbage looper, was blown in on winds from the South. The moth seems to prefer the succulent peas of the Green Giant Co. of Le Sueur, Minn., to anything it can find down South. It does not greatly damage pea crops, but does fold its wings and crumple into a pea-sized ball. This protective masquerade has caused it to turn up in pea cans. While local entomologists say the moth is high in vitamins, it distinctly lacks consumer acceptance and pea growers have been using carbaryl as enthusiastically as corn growers.

In mid-October, Minnesota beekeepers met with representatives of three large canneries in the first of a series of meetings that they hope will produce a way to save the bees. More is at stake than honey. Alfalfa is a big cash crop that requires bees as pollinators. So do fruit trees, squash, legumes and a host of other crops that nationally amount to some $1 billion worth of agricultural products a year.

"We think better understanding of the essential agricultural role of bees will persuade insecticide-users to take every step possible to protect these